

RUSSIAN FINANCIAL CRISIS OF 1998: AN ECONOMETRIC INVESTIGATION

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Abstract

This article aims at deriving lessons from the Russian financial crisis through examining the root causes of the crisis based on a probit model incorporating 20 monthly macroeconomic and financial sector indicators spanning the period 1988:1 – 1998:8. The results turned out to be as expected. Strong evidence emerged suggesting that the significant variables are foreign direct investment/GDP, inflation, world oil prices, real interest rates, current account/GDP, GDP per capita, foreign exchange reserves, stock prices, real exchange rate, and export growth. Signs of the variables were mostly in line with what one would have expected, except public debt, bank reserves / bank assets, real interest rates, and lending and deposit rate spread.

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I. Introduction

After the demise of the USSR in the latter part of the 20th century, Russia pegged the ruble to the US dollars to cope with high levels of inflation. Up to late 1997, the sales of ruble denominated discount instruments and coupon bonds, known as GKO's and OFZ's, by the government were successful. In 1998, however, the government began facing difficulties selling ruble denominated debt due to adverse domestic political developments, weak commodity prices, and global economic events. Hence, the government decided to replace the ruble denominated debt into US dollar denominated Eurobonds. The growing burden of borrowing had raised concerns

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about Russia's default on its treasury bills as pressures on debt, equity, and exchange markets decreased the investors' confidence. During this time, Russia had made herself extremely vulnerable to adverse external developments. It became highly dependent on a healthy global economy, as its capital flow model was based excessively on the existence of a demand for exports. When the East Asian financial crisis break out in 1997, prices for Russia's two most valuable sources of capital flows, energy and metals, plummeted. Given Russia's fragile economy, the rapid decline in the value of those two capital sources resulted in an economic chaos in the country where GDP per capita fell, unemployment soared, and global investors liquidated their Russian assets. By July 1998, Russian government was unable to rollover treasury bills maturing before the end of 1999. On August 17, 1998, Russian government abandoned to defend the exchange rate peg, declared unilateral default on \$40 billion in short-term domestic treasury debt, of which about one third was held by foreign investors, and placed a 90-day moratorium on commercial external debt payments.

This article aims at deriving lessons from the Russian financial crisis through examining the root causes of the crisis based on a probit model incorporating 20 monthly macroeconomic and financial sector variables. This article is structured as follows. Section 2 reviews the literature on financial crises. Section 3 presents the data and introduces the methodology followed. Section 4 presents the results and the last section points out the conclusions that emerge from the study.

2. Literature Review

As seen in Feridun (2004), literature on financial crises is categorized into three mainstream models, namely first-generation models, second-generation models, and third-generation models. In the "first-generation" models (Krugman 1979; Flood and Garber 1984), a government with persistent money-financed budget deficits is assumed to use a limited stock of reserves to peg its exchange rate and the attempts of investors to anticipate the inevitable collapse generates a speculative attack on the currency when reserves fall to

some critical level. In "second-generation" models (Obstfeld 1994, 1996, Ozkan and Sutherland 1995, Radelet and Sachs 1998) policy is less mechanical: a government chooses whether or not to defend a pegged exchange rate by making a tradeoff between short-run macroeconomic flexibility and longer-term credibility. The crisis then arises from the fact that defending parity is more expensive as it requires higher interest rates. Should the market believe that defense will ultimately fail, a speculative attack on a currency develops either as a result of a predicted future deterioration in macro fundamentals, or purely through self-fulfilling prediction. The need for third generation models became apparent in 1990s with Mexican Tequila crisis of 1994 and the East Asian crisis of 1997. A number of new approaches have emerged to explain how these crises evolved and how they spread from country to country. Third-generation models (Dooley 1997, Krugman 1998, Radelet and Sachs 1998) are categorized into three different groups such as herd-behavior, contagion, and moral hazard.

Probit and logit models, pioneered by Frankel and Rose (1996), use limited dependent variable models known as probit or logit regressions to identify the causes of crises and to predict future crises. This approach defines a crisis indicator equal to one or zero depending on whether a currency crisis does or does not occur within the specified time period. Frankel and Rose (1996) attempted to find out how international debt structure and external factors affected the probability of currency crises. They used a number of external, internal and foreign macroeconomic variables in a multivariate probit model specified for 105 developing countries, covering annual data from 1971 to 1992. They defined a crisis as at least 25% depreciation of the nominal exchange rate that also exceeds the previous year's depreciation level by at least 10% and constructed a dummy crisis variable according to that rule. Results of their model indicate that the significant variables are output growth, foreign direct investment/total debt, reserves, domestic credit growth, external debt and foreign interest rates. Sachs, Tornell and Velasco (1996) also used a probit model to analyze currency crises, particularly the Mexican Tequila Crisis of 1995, using a sample of 20 emerging countries that were vulnerable to contagion effect. They used the

weighted sum of the percent decrease in reserves and the percent depreciation of the exchange rate as their crisis index. They found that crises happened only in the countries with weak fundamentals such as low reserves, fragile banking systems and overvalued exchange rate. They also found evidence showing that short-term capital inflows do not matter when reserves and fundamentals are strong whilst government consumption and current account deficits matter only in the countries with weak fundamentals and weak reserves. Berg and Pattillo (1999) tested models offered by Kaminsky, Lizondo and Reinhart (1998), Frankel and Rose (1996) and Sachs, Tornell, Velasco (1996) to see if these models could predict the Asian Crisis using information available at the end of 1996. They found out that the models offered by Sachs, Tornell, Velasco (1996) and Frankel and Rose (1996) were ineffective in forecasting the Asian Crisis. The Kaminsky, Lizondo and Reinhart (1998) model, on the other hand, proved to be successful. Crisis probabilities generated by this model for the period between May 1995 and December 1996 were statistically significant predictors of actual crisis occurrence over the following 24 months. Berg and Pattillo (1999) also found out that in all three approaches, the probability of a currency crisis increases when domestic credit growth is high, the real exchange rate is overvalued relative to trend, and the ratio of M2 to reserves is high. In a recent study, Komulainen and Lukkarila (2003) examined the causes of financial crises in 31 emerging market countries during 1980-2001 using a probit model based on 23 variables. Their findings show that financial crises occur together with banking crises and an increase in private sector liabilities, public debt, foreign liabilities of banks, unemployment, inflation, and US interest rates raises the probability of a crisis. Feridun (2004) summarizes the empirical literature on financial crises.

3. Data and Methodology

The probit model is estimated for a set of 20 monthly observations spanning the period 1988:1 – 1998:8. Most data are gathered from DataStream. The data for government debt figures come from several sources, including International Financial Statistics, the World

Bank's WDI and IMF country reports. The tested 20 indicators are selected on the basis of currency crisis theories and previous empirical literature. In addition to the traditional macroeconomic variables, we include several indicators describing the vulnerability of domestic banks. These indicators include the growth of bank deposits, the ratio of the lending rate to the deposit rate, and the ratio of bank reserves to assets. We also employ variables that indicate vulnerability to a sudden stop of capital inflows. These variables are public debt, broad money to reserves, and private sector liabilities. To study foreign influences on crises, we include the US interest rate and the world oil prices. In 1998, fuel, that is, crude oil and petroleum products plus natural gas, accounted for 43% of Russian exports (Economist Intelligence Unit, 1998). Since we study all these variables simultaneously, we hope to distinguish those indicators that reflect actual causes of the recent crises in emerging markets. The probit model is set up as follows:

$$y_t^* = X_{t-i} \beta + \varepsilon_t \quad \varepsilon_t \sim N(0, s^2) \quad (1)$$

$$CRISIS_t = X_{t-i} \beta + \varepsilon_t \quad \varepsilon_t \sim N(0, s^2) \quad (2)$$

where $CRISIS_t$ is assumed to be an observable process for each country and its position in time t depends on information available at time $t-1$ and the random error term ε . We observe y in such a way that:

$$y = 1 \text{ if } CRISIS_t > 0 \quad (3)$$

$$y = 0 \text{ if } CRISIS_t < 0 \quad (4)$$

Therefore, the probability that $y = 1$ is the probability that:

$$CRISIS_t > 0, \text{ or,} \quad (5)$$

$$P(CRISIS_t > 0) = P(X\beta + \varepsilon > 0) = P(\varepsilon > -X\beta) \quad (6)$$

where X is the vector of explanatory variables. As shown in equations (3) and (4), a binary dummy crisis variable is constructed for the financial crises. This dummy variable takes the value of one or zero depending on whether a currency crisis does or does not occur. If the crisis takes place, the dependent variable takes the value

of 1. Otherwise it remains 0. The dependent variable is then regressed on the explanatory variables.

The probit model assumes that the probability distribution function corresponds to normal distribution. Since in currency crisis situation a successful attack leads to sharp currency depreciation and substantial reserve losses, both the signal approach and limited dependent models traditionally define a currency crisis as a discrete event. One common technique is to construct an index of exchange market pressure as a weighted average of exchange rate changes and reserves changes (as well as interest rates in some cases). The crisis is said to occur when the index exceeds a certain threshold level. At this point, we calculate an exchange market pressure index (EMP) for Russia. The index includes exchange rate depreciation and loss of reserves, which are weighted to influence equally. The exchange market pressure index takes the form:

$$EMP = \Delta e - (s_e/s_r) * \Delta r \quad (2)$$

where Δe denotes the change in exchange rate and Δr in international reserves, s_e and s_r denote the standard deviation of exchange rate alteration and reserves, respectively. We determine the values of the EMP index more than two standard deviations above the mean as a crisis. Since macroeconomic variables often worsen prior to the actual crisis, we define as a crisis not only the crisis month but also the eleven months before. In other words, we use a one-year window for our variables.

4. Empirical Results

As Table 1 indicates, the signs of the variables are mostly in line with our expectations, with the exception of public debt, bank reserves / bank assets, real interest rates, and lending and deposit rate spread. The significant variables are foreign direct investment/GDP, inflation, world oil prices, real interest rates, current account/GDP, GDP per capita, foreign exchange reserves, stock prices, real exchange rate, and export growth. Table 2 summarizes the results of the study. These results come with no surprise. The Russian GDP, for instance, contracted 4.6% in 1998 and a contracting economy is more vulnerable to financial crises. It is noticeable that the year 1998 was a

particular year for Russia as real GDP reached the minimum value of the period 1990-2003, starting to increase afterwards. The Russian inflation rate, on the other hand, was 84.4% in 1998, almost 73% higher than that of the previous year. During the same period, Russian interest rates increased sharply as a sign of loss of investor confidence, and the value of the ruble plummeted.

Table 1 Probit Model Results

<u>Variable</u>	<u>Coefficient</u>	<u>Z-</u> <u>statistic</u>	<u>Variable</u>	<u>Coefficient</u>	<u>Z-</u> <u>statistic</u>
Inflation	42.14	1.74*	US interest rates	3.12	0.442
Real exchange rate	-29.12	1.68*	FDI / GDP	-9.12	1.873*
Export growth	-1.34	-1.69*	World Oil Prices	-13.21	1.678*
Import growth	0.23	-0.22	Real interest rate	-11.14	1.681*
M1	0.34	9.83	Public debt / GDP	-6.43	0.56
Domestic credit / GDP	11.35	0.71	Current account/GDP	-6.51	1.67*
Stock prices	-24.83	-1.67*	GDP per capita	-21.12	1.66*
Terms of trade	-11.83	-0.11	Fiscal balance / GDP	36.98	0.27
Lending and deposit rate spread	-0.14	0.09	M2 / foreign exchange reserves	20.92	0.62
Bank reserves / bank assets	-0.01	0.12	Foreign exchange reserves	-22.95	2.86***
* Significant at the 10% level.** Significant at the 5% level, *** Significant at the 1% level.					

Table 2. Regression Summary

Variable	Expected Sign	Found Sign	(3)	Variable	Expected Sign	Found Sign	(6)
Inflation	+	+	*	US interest rates	+	+	
Real Exchange Rate	-	-	*	FDI / GDP	-	-	*
Export Growth	-	-	*	World Oil Prices	-	-	*
Import Growth	+	+		Real interest rate	+	-	*
M1	+	+		Public debt / GDP	+	-	
Domestic Credit/GDP	+	+		Current account/GDP	-	-	*
Stock Prices	-	-	*	GDP per capita	-	-	*
Terms of Trade	-	-		Fiscal balance / GDP	+	+	
Lending and deposit rate spread	+	-		M2 / foreign exchange reserves	+	+	
Bank reserves / bank assets	+	-		Foreign exchange reserves	-	-	***
Columns (3) and (6): * Significant at the 10% level.** Significant at the 5% level.*** Significant at the 1% level.							

At the end of July 1998, the US dollar – ruble exchange rate stood at \$1=R6.235. By the end of August 1998 it declined to \$1=R7.905, and by the end of September it had declined to \$1= R16.064. Due to the sharp depreciation of the ruble, Russian foreign exchange reserves declined. Besides, the Russian Central Bank sold foreign exchange in order to maintain a stable exchange rate for the ruble when the ruble was facing downward pressure until August 1998. Regarding external factors, world prices for oil, along with other raw

materials had been declining owing to the East Asian financial crisis of 1997. Russia was heavily dependent on exports of these products for its foreign reserves. At the end of January 1999, the price of Russian crude oil was roughly \$11/barrel, down from \$16/barrel at the beginning of the same month. Again, owing to the East Asian crisis of 1997 investors were highly risk averse and international capital began to leave Russia upon ailing economic indicators.

5. Conclusions

This study analyzed the causes of the Russian Financial Crisis of 1998. It estimated a probit model spanning the period 1988:1 – 1998:8. The results turned out to be as expected. Strong evidence emerged suggesting that the significant variables are foreign direct investment/GDP, inflation, world oil prices, real interest rates, current account/GDP, GDP per capita, foreign exchange reserves, stock prices, real exchange rate, and export growth. Signs of the variables were mostly in line with what one would have expected, except public debt, bank reserves/bank assets, real interest rates, and lending and deposit rate spread.

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